Detection of Ischemia: Which Test in Which Patient?

Thomas Ryan, MD
Director, Ohio State’s Heart and Vascular Center
A General Approach to Stress Testing

Method to Induce Ischemia
- Robust
- Flexible
- Generalizable
- Safe

Method to Detect Ischemia
- Versatile
- Multiparametric
- Safe
- Accurate

Clinical Utility of the Test
Options

- Plain-old treadmill
- Nuclear (eg, sestamibi)
- Stress echo
- Stress MRI
- PET
Stress Testing: Cost vs Yield

Accuracy

Approx Cost $

- Clinical
- ExECG
- ExEcho
- ExMIBI
- PET

Approx Cost:
- 100
- 210
- 460
- 910
- 1200

Cost in Approx $:
- 100
- 210
- 460
- 910
- 1200

Clinical

ExECG

ExEcho

ExMIBI

PET
Limitations of the Stress ECG

False-pos Rate

Men: 7-44%
Women: 39-67%
When is POT Good Enough?

- Baseline ECG
- Meds
- Gender
- Level of stress
- Localization?
## Comparing Advantages

<table>
<thead>
<tr>
<th>Echo</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Versatile</td>
<td>High success rate</td>
</tr>
<tr>
<td>Lower cost</td>
<td>Peri-infarct ischemia</td>
</tr>
<tr>
<td>Convenient</td>
<td>Extensive data, eg, prognosis</td>
</tr>
<tr>
<td>Noninvasive</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Accurate</td>
<td></td>
</tr>
</tbody>
</table>

Know which test is best in your hospital!
Prognostic Value of Stress Echo

- Normal wall motion
- Abnormal studies
- Preserved exercise capacity
- Severe LV dysfunction
- Women
- Post-MI
- Post-CABG
- Post-PTCA
- Elderly
- Diabetes
Factors Affecting Stress Testing Results

Pretest Likelihood vs. Posttest Likelihood

- **Pos Result**
- **Neg Result**

100% on both axes.
Factors Affecting Stress Testing Results

100 pts Pretest Likelihood 10%

CAD + 10 pts

Sensitivity = 90%
Specificity = 60%

False Positives 2 pt

81 pts

% of positive tests that are false-positive = 53%

% of negative tests that are false-negative = 2%

A negative result is helpful, but over half of patients sent to the cath lab are normal!!
When to do the test? (and when not to)

**Good Idea!**

- 64 yo man with CRF, abn ECG, and atypical chest pain
- 52 yo man with acute CP, neg ECG, and neg Tn
- 59 yo woman recovering from NSTE MI, no early cath
- 62 yo diabetic prior PVS
- 55yo man with recent CP, low pre-test prob of CAD, NSSTTW changes
- 70 yo woman with EF 25% being considered for CABG
- 54 yo man with + Tn, but no Sx or ischemic ECG changes
- 62 yo man with CP and recent cath showing 50% mid LAD lesion

**Bad Idea!**

- 68 yo man with multiple RF and increasing cp
- 33 yo woman with atypical CP, nl ECG
- 60 yo obese woman with very poor apical windows
- 78 yo woman with known CAD but no revasc targets
- 48 yo diabetic prior to cataract surgery
- 47 yo woman, new onset AF, no hx of CP or CAD
- 60 yo man ASx, multiple RF, 2y after CABG
- 41 yo woman with no RF and a normal ECG
- 56 yo ASx man with mod Framingham risk profile, interpretable ECG
Limitations of Stress Echo

- Image quality – endocardial definition
- Modest sensitivity/specifcity
- Subjective interpretation
- Nonquantitative
- Reliance on wall motion
- Overutilization
Stress MRI:
A 42 yo woman with atypical chest pain
Exercise MRI: Initial Experience
Feasibility of real-time exercise stress CMR

Exercise CMR Results

Resting cine

Stress cine

Stress perfusion
Multidetector CT
Cardiac CT

LAD

LCX

RCA
Table 2. Diagnostic Accuracy of Coronary MSCT Compared to QCA for Detection of Lesions >50% in Patients

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients (n = 70)</td>
<td>38/40 (95%)</td>
<td>27/30 (90%)</td>
<td>38/41 (93%)</td>
<td>27/29 (93%)</td>
</tr>
<tr>
<td>Arteries (n = 279)</td>
<td>63/69 (91%)</td>
<td>194/210 (92%)</td>
<td>63/79 (80%)</td>
<td>194/200 (97%)</td>
</tr>
<tr>
<td>Segments (n = 935)</td>
<td>79/92 (86%)</td>
<td>802/843 (95%)</td>
<td>79/120 (66%)</td>
<td>802/815 (98%)</td>
</tr>
</tbody>
</table>

Raff et al. JACC ’05
Limitations of CTA
Summary

- More options than ever
- Exercise usually preferred over pharmacologic
- Pretest probability more important than sensitivity/specificity
- Cost and radiation should factor in
- Payers beginning to dictate choices